

WHAT IS CLAIMED IS:

1. A photodetector integratable light coupling apparatus, comprising:

a substrate having a photodetector mounted on a predetermined area thereof; and

5            an etch structure complex formed in the substrate and having a total reflection surface that is total-reflection coated to have a first predetermined angle and an anti-reflection surface that is anti-reflection coated to have a second predetermined angle,

             wherein light incident from outside is reflected at the total reflection  
10    surface, and then the incident light is transmitted to and passed through the anti-reflection surface, and transmitted to the photodetector.

             2. The photodetector integratable light coupling apparatus according to claim 1, wherein the photodetector is any one of a surface-illuminated  
15    photodetector and an edge-coupled photodetector.

             3. The photodetector integratable light coupling apparatus according to claim 1, wherein the photodetector is any one of a planar / waveguide p-i-n photodetector, a resonant cavity / waveguide avalanche photodetector, a  
20    velocity matched distributed photodetector, a single / periodically-distributed unitravelling carrier photodetector, and a metal-semiconductor-metal photodetector.

4. The photodetector integratable light coupling apparatus according to claim 1, further comprising a waveguide formed between the photodetector and the anti-reflection surface, in case where the photodetector is an edge-coupled photodetector.

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5. The photodetector integratable light coupling apparatus according to claim 1, wherein the etch structure complex further comprises the total reflection surface and/or the anti-reflection surface to make the incident light detected through one or more photodetectors.

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6. The photodetector integratable light coupling apparatus according to claim 1, wherein the total reflection surface is coated by any one of a metal layer, such as Au and Ag, a single dielectric thin film, such as  $\text{SiO}_x$ ,  $\text{SiN}_x$ ,  $\text{CeO}_2$ ,  $\text{CeF}_3$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{MgF}_2$  and  $\text{ZnS}$ , and a multiple-layer composed of a combination thereof.

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7. The photodetector integratable light coupling apparatus according to claim 1, wherein the anti-reflection surface is coated by any one of a single-layer, a double-layer and a multi-layer composed of a dielectric thin film, such as  $\text{SiO}_x$ ,  $\text{SiN}_x$ ,  $\text{CeO}_2$ ,  $\text{CeF}_3$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{MgF}_2$  and  $\text{ZnS}$ .

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8. The photodetector integratable light coupling apparatus according claim 1, wherein the substrate is an InP substrate.

9. The photodetector integratable light coupling apparatus according claim 1, wherein the etch structure complex is manufactured in the same epi-structure as the photodetector.

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10. A photodetector integratable light coupling apparatus, comprising:  
a substrate having a surface-illuminated photodetector mounted on a predetermined area thereof; and

an etch structure complex including: a first anti-reflection surface that  
10 passes through incident light entering into the substrate; a first total reflection surface coated so that the incident light may be totally reflected with a first predetermined angle and transmitted to the photodetector; and a second total reflection surface for transmitting the light, which is not absorbed into the photodetector and reflected back, to the photodetector,

15 wherein the light incident from outside passes through the first anti-reflection surface and is reflected from the first total reflection surface to be transmitted and absorbed into the photodetector, and

wherein the light, which is not absorbed into the photodetector and reflected, passes through the second total reflection surface and is absorbed  
20 again into the photodetector.

11. The photodetector integratable light coupling apparatus according to claim 10, further comprising:

one or more total reflection surfaces for transmitting the light, which is not absorbed into the photodetector and reflected back, to the photodetector.

12. The photodetector integratable light coupling apparatus according to claim 10, wherein the total reflection surface is coated by any one of a metal layer, such as Au and Ag, a single dielectric thin film, such as  $\text{SiO}_x$ ,  $\text{SiN}_x$ ,  $\text{CeO}_2$ ,  $\text{CeF}_3$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{MgF}_2$  and  $\text{ZnS}$ , and a multiple-layer composed of a combination thereof.

13. The photodetector integratable light coupling apparatus according to claim 10, wherein the anti-reflection surface is coated by any one of a single-layer, a double-layer and a multi-layer composed of a dielectric thin film, such as  $\text{SiO}_x$ ,  $\text{SiN}_x$ ,  $\text{CeO}_2$ ,  $\text{CeF}_3$ ,  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{MgF}_2$  and  $\text{ZnS}$ .

14. The photodetector integratable light coupling apparatus according to claim 10, wherein the substrate is an InP substrate.

15. The photodetector integratable light coupling apparatus according to claim 14, wherein the InP substrate in the etch structure complex is manufactured to have a sloping surface with a sloping angle according to a combination of an etching mask direction and an etching method using an HBr-based etchant or an HCl-based etchant.

16. The photodetector integratable light coupling apparatus according claim 10, wherein the etch structure complex is manufactured in the same epi-structure as the photodetector.